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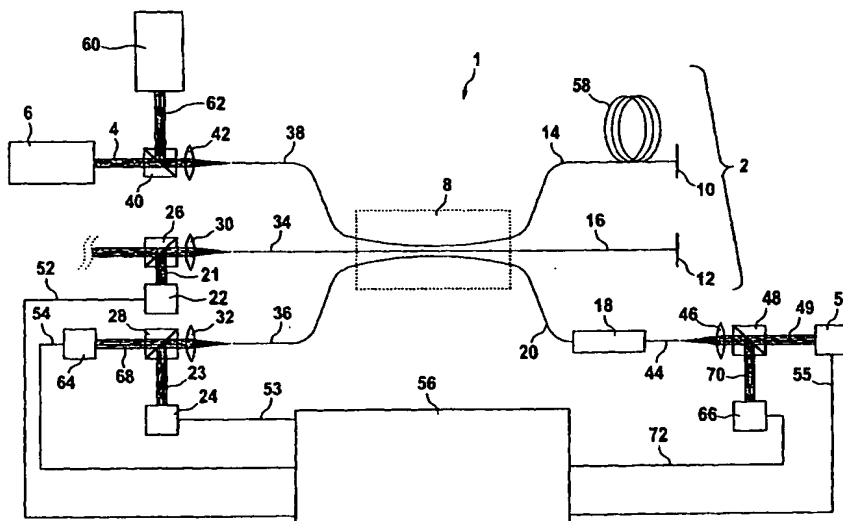
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(54) Title: INTERFEROMETER MONITORING



(57) Abstract: The present invention relates to an apparatus and to a method of monitoring an interferometer (2), comprising the steps of: coupling a first optical signal (62) into the interferometer (2) and into a wavelength reference element (18), detecting a first resulting interference signal (68) being a result of interference of parts of the first optical signal (62) in the interferometer (2), detecting a resulting reference signal (70) of the wavelength reference element (18), the resulting reference signal (70) being a result of interaction of the first optical signal (62) with the wavelength reference element (18), and comparing the first resulting interference signal (68) with the resulting reference signal (70) to detect a drift of the interferometer (2), if any.

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INTERFEROMETER MONITORING

BACKGROUND OF THE INVENTION

The present invention relates to interferometer monitoring, in particular to a method and an apparatus for monitoring an interferometer, more particular to a method and an apparatus for stabilizing an interferometer.

SUMMARY OF THE INVENTION

It is an object of the invention to provide improved interferometer monitoring. The object is solved by the independent claims. Preferred embodiments are shown by the dependent claims.

10 Due to a preferred embodiment of the present invention it is possible to monitor an interferometer, in particular to monitor an interferometer regarding its drift, in particular its drift dependent on temperature, pressure, humidity, magnetism and/or voltage.

15 According to a further embodiment of the present invention it is possible to detect the temperature, pressure, humidity, magnetism, voltage dependency of properties of a device under test if the device under test is incorporated in the interferometer.

20 According to an embodiment it is possible to stabilize the interferometer on the basis of the detected drift, in particular to stabilize the interferometer to perform a measurement of the wavelength of an optical signal with unknown wavelength independent of temperature, pressure, humidity, magnetism or voltage influencing the interferometer, therefore providing an absolute wavelength reference unit having so far unknown accuracy.

25 Furthermore, according to an embodiment of the present invention it is possible to tune a useful optical signal of a laser source independent of temperature, pressure, humidity, magnetism and/or voltage in the area of the interferometer. Therefore, it is possible to perform high precision measurements using a

continuously swept tunable laser source.

In a further preferred embodiment the first optical signal is substantially permanently swept in wavelength up and down, preferably within a predetermined sweeping range, the sweeping range preferably covering an absorption feature of the wavelength reference element, the latter being preferably a gas absorption cell. Using this method it is possible to monitor and preferably stabilize the interferometer in a fast and precise way.

In another embodiment the first optical signal is locked to an absorption feature of the wavelength reference element. When still detecting a first resulting interference signal being a result of interference of parts of the first optical signal in the interferometer it is clear that this interference can only be the result of a temperature, pressure, humidity, magnetism and/or voltage dependent drift of the interferometer itself since the first optical signal is locked to the absolute wavelength reference of the wavelength reference element. Furthermore, it is possible to detect a second resulting interference signal being a result of interference of parts of the first optical signal in the interferometer and to compare the phase of the first and the second resulting interference signals to evaluate the direction of the drift, e.g. by a direction sensitive fringe counting method using the two detected interference signals.

In a preferred embodiment of the present invention there is additionally provided a second optical signal by a second optical source to the interferometer and to the wavelength reference element using a further detector for detecting a second resulting interference signal being a result of interference of parts of the second optical signal in the interferometer, and a locking circuit for locking the second optical signal to a specified position, such as an extremum, of the second resulting interference signal, and a further detector for detecting a change of a beat signal of a superposition of the first and the second optical signal to detect the drift. Preferably the second optical signal has a slightly different wavelength with respect to the first optical signal and has the same polarization with respect to the first optical signal. However,

both signals can use the same path. It is clear that if a deviation of a beat signal occurs between the two optical signals the specified position of the second resulting interference signal must have suffered from a temperature, pressure, humidity, magnetism and/or voltage dependent drift of the interferometer which drift can thereby be detected.

According to an embodiment of the present invention the detected drift can be compensated by a variable optical delay provided by a variable optical delay unit. This unit can be introduced anywhere in the interferometer. The unit can preferably use an element, which can vary a refractive index within the interferometer path to change the optical path length within such a path. The unit can preferably comprise a liquid crystal to perform quick changes of the optical path to provide a quick reaction on fast temperature, pressure, humidity, magnetism and/or voltage dependent changes of the properties of the monitored interferometer.

It is further preferred to use another optical signal similar to the first optical signal but having a substantially different wavelength. Coupling such further optical signal preferably in the same path as the first optical signal and locking such further optical signal to the same optical wavelength reference element and also detecting a resulting interference signal of such further optical signal it is possible to evaluate a wavelength dependency of the detected drift if there occurs a difference between the drift evaluated on the basis of the first optical signal compared to the drift of the interferometer evaluated on the basis of the further optical signal having a substantially different wavelength.

It is preferred to use the same polarization for the first, the second and the further optical signal but to use a polarization of the useful optical signal which is orthogonal to the first, the second and/or the further optical signal so that there is no polarization cross coupling between the useful optical signal and the other optical signals within the interferometer, in particular when some or all of the optical signals use the same optical path.

The invention can be partly embodied or supported by one or more suitable

software programs, which can be stored on or otherwise provided by any kind of data carrier, and which might be executed in or by any suitable data processing unit. Software programs or routines are preferably applied to the realization of the inventive method.

5 BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and many of the attendant advantages of the present invention will be readily appreciated and become better understood by reference to the following detailed description when considering in connection with the accompanied drawings. The components in the drawings are not necessarily to
10 scale, emphasis instead being placed upon clearly illustrating the principles of the present invention. Features that are substantially or functionally equal or similar will be referred to with the same reference sign(s).

Fig. 1 to 5 show schematic illustrations of embodiments of the present invention.

15 DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

Referring now in greater detail to the drawings, Fig. 1 shows an apparatus 1 for monitoring an interferometer 2. The displayed apparatus 1 is used for evaluating a wavelength of a useful optical signal 4 of a tunable laser source 6.

20 Interferometer 2 comprises a three-port coupler 8, two Faraday mirrors 10 and 12 connected via fibers 14, 16 to coupler 8, photodiodes 22 and 24 serving as detectors and connected to coupler 8 via polarization beam splitters 26, 28, lenses 30, 32 and fibers 34, 36, and a fiber 38 into which the useful optical signal 4 is supplied via a polarization beam splitter 40 and a lens 42.

25 Additionally, coupler 8 is connected to an absorption cell 18 via a fiber 20. A signal of outgoing fiber 44 of absorption cell 18 is detected via a lens 46 and a polarization beam splitter 48 by a detector 50.

Detectors 22, 24 and 50 are connected via connecting lines 52, 53 and 55 to an evaluation unit 56.

An evaluation of a wavelength of the optical signal 4 by the evaluation unit 56 works as follows: optical signal 4 of unknown wavelength is coupled via polarization beam splitter 40 and lens 42 into fiber 38 of interferometer 2. Coupler 8 connected to fiber 38 splits the optical signal 4 into three parts that are coupled into fibers 14, 16 and 20. Into fiber 14 there is introduced a delay by a loop 58 so that the respective part traveling through fiber 14 and being reflected by Faraday mirror 10 is delayed with respect to the part traveling through fiber 16 and being reflected by Faraday mirror 12. Therefore, interference between the two reflected signals occurs in coupler 8 and interference fringes in resulting superimposed signals 21 and 23 can be detected via fibers 34, 36, lenses 30, 32 and polarization beam splitter 23, 26, 28 by the detectors 22 and 24.

The fringes of interference in signals 21 and 23 detected by detectors 22 and 24 are digitally counted by evaluation unit 56. The presence of two photodiodes 22, 24 allows for a direction sensitive fringe counting by the evaluation unit 56. Since the third part of optical signal 4 is coupled out of coupler 8 via fiber 20 into absorption cell 18, and the output signal 49 of absorption cell 18 can be detected via fiber 44, lens 46, polarization beam splitter 48 by the detector 50, a calibration of the interferometer 2 is possible by determining the free spectral range (FSR) of the interferometer 2 on the basis of the known absorption features of absorption cell 18 serving as a wavelength reference element according to this embodiment of the present invention. As a gas for the absorption cell 18 C_2H_2 can be used.

Interferometer 2 is exposed to external factors as temperature, pressure, humidity, magnetism and/or voltage, which factors result in a time dependent phase shift and a varying FSR. Therefore, apparatus 1 according to the embodiment displayed in Fig. 1 is employed to monitor and stabilize the performance of interferometer 2, with evaluation and stabilizing unit 56

detecting a temperature, pressure, humidity, magnetism and/or voltage dependent drift of interferometer 2 and providing a value of the measurement of the wavelength of optical signal 4 considering the evaluated drift of interferometer 2.

- 5 For the aforementioned purposes apparatus 1 comprises a distributed feedback (DFB) laser 60 providing a first optical signal 62 to the polarization beam splitter 40 for coupling the first optical signal 62 into the interferometer 2 and into the wavelength reference element 18. Since both optical signals 4 and 62 are provided to the polarization beam splitter 40 they can travel the same
- 10 paths in interferometer 2 since they are orthogonal polarized by polarization beam splitter 40 so that there is no polarization cross coupling between optical signals 4 and 62. Accordingly, polarization beam splitters 28 and 48 enable the detection of a first resulting interference signal 68 with the help of a detector 64, the first resulting interference signal 68 being a result of interference of
- 15 parts of the first optical signal 62 in the interferometer 2, and to detect a resulting reference signal 70 of the wavelength reference element 18, the resulting reference signal 70 being a result of interaction of the first optical signal 62 with the wavelength reference element 18, with the help of a detector 66. Detectors 64 and 66 are connected to evaluation unit 56 via connecting
- 20 lines 54 and 72 to enable evaluation unit 56 to compare the first resulting interference signal 68 with the resulting reference signal 70 to detect a drift of the interferometer 2, if any. To facilitate this comparison the DFB laser 60 is permanently wavelength swept within a predetermined wavelength sweeping range which range covers at least one complete absorption feature of
- 25 absorption cell 18 so that the first resulting interferometer signal 68 at photo detector 64 and the absorption spectrum of reference cell 18 detected by detector 66 can be compared and a possible FSR drift can be interfered by the evaluation unit 56.

Fig. 2 shows a second apparatus 200 according to a second embodiment of

30 the present invention. According to Fig. 2 in apparatus 200 the first optical signal 62 of DFB laser 60 is locked to an absorption feature of absorption cell

18 via a locking circuit 202. Locking circuit 202 comprises a mixer 204 receiving a signal of detector 66 by a connecting line 206 and a local oscillator signal 210 of DFB laser 60 by a connecting line 208 and outputting a locking signal via a connecting line 212 to DFB laser 60. Alternatively, DFB laser 60 can be a laser
5 having a fixed wavelength of first optical signal 62.

The function of embodiment 200 is as follows: if evaluation unit 56 detects interference fringes by photo detector 64 it is clear that a drift of interferometer 2 has occurred. To detect the direction of the drift apparatus 200 comprises a further detector 214 to provide evaluation unit 56 with two detector signals 54
10 and 216 of detectors 64 and 214 to enable evaluation unit 56 for a direction sensitive fringe counting on the basis of a comparison of the phase of the first resulting interference signal 68 and a second resulting interference signal 218.

Fig. 3 shows an apparatus 300 according to a third embodiment of the present invention. Additional to apparatus 200 of Fig. 2 apparatus 300 comprises a
15 second DFB laser 302 providing a second optical signal 304 via a semi transparent mirror 306, polarization beam splitter 40, lens 42 to interferometer 2 and to absorption cell 18. Optical signal 304 of DFB laser 302 is locked to a specified position, such as an extremum, of the second resulting interference signal 68 by a locking circuit 308.

20 Apparatus 300 of Fig. 3 works as follows: Since both the first optical signal 62 and the second optical signal 304 have the same polarization both signals will interfere in interferometer 2 and create a beat signal 70 at detector 66 if there is a drift of interferometer 2, which beat signal 70 is detected by heterodyne measurement and delivered by the connecting line 72 to evaluation unit 56. To
25 achieve the best results a very broad frequency range for the beat frequency measurement by detector 66 should be realized.

Fig. 4 shows an apparatus 400 according to a fourth embodiment of the present invention. Apparatus 400 is substantially the same as apparatus 200 of Fig. 2 but further comprises a variable optical delay unit 402 introduced into
30 interferometer 2 into path 14. Delay unit 402 is connected by a connecting line

404 to evaluation unit 56. If evaluation unit 56 evaluates a drift of interferometer 2 it can generate a control signal by a not shown control signal generator and deliver that control signal by connecting line 404 to variable optical delay unit 402 to introduce a variable optical delay into path 14 of interferometer 2 thereby compensating a possible drift of interferometer 2. Such a variable optical delay unit controlled by evaluation unit 56 can be introduced in all embodiments 100, 200, 300, 400 and 500. As a variable optical delay unit 402 it is possible to use any element, which can vary the refractive index of path 14, e.g. a liquid crystal.

Fig. 5 shows an apparatus 500 according to a fifth embodiment of the present invention. Additional to the apparatus 200 of Fig. 2 apparatus 500 comprises a further laser source 502. In this embodiment DFB laser 502 generates a third optical signal 504, which has a wavelength substantially far away from the wavelength of first optical signal 62 of DFB laser 60. The third optical signal 504 is coupled into the interferometer and into a wavelength reference unit 506.

In Fig. 5 wavelength reference unit 506 is introduced for simplification of the drawing, only. Besides that wavelength reference unit 506 comprises the same elements as in the other embodiments shown in the drawings, i.e. the absorption cell 18, lens 46, polarization beam splitter 48 and detectors 50 and 66. Apparatus 500 is similar to apparatus 200 but furthermore comprises a locking circuit 510 locking the optical signal 504 of DFB laser 502 to an absorption feature of the absorption cell 18. Locking circuit 510 comprises the same elements as locking circuit 202, i.e. an incoming connecting line 206 from the wavelength reference unit 506, an incoming line 514 delivering the local oscillator signal 518 to a mixer 512 which mixer supplies a locking signal 516 to DFB laser 502. Thereby, it is possible to detect a wavelength dependency of any drift of the interferometer 2, also.

All shown embodiments 100, 200, 300, 400 can not only be used for the described purposes but can also be used to determine properties of a device under test incorporated into the interferometer 2.

CLAIMS:

1. A method of monitoring an interferometer (2), comprising the steps of:
coupling a first optical signal (62) into the interferometer (2) and into a wavelength reference element (18),
5 detecting a first resulting interference signal (68) being a result of interference of parts of the first optical signal (62) in the interferometer (2),
detecting a resulting reference signal (70) of the wavelength reference element (18), the resulting reference signal (70) being a result of interaction of the first optical signal (62) with the wavelength reference
10 element (18), and
comparing the first resulting interference signal (68) with the resulting reference signal (70) to detect a drift of the interferometer (2), if any.
2. The method of claim 1, further comprising the steps of:
substantially permanently sweeping a wavelength of the first optical signal
15 (62) up and down.
3. The method of claim 1 or any one of the above claims, further comprising the steps of:
substantially permanently sweeping a wavelength of the first optical signal (62) up and down within a predetermined sweeping range.
- 20 4. The method of claim 1 or any one of the above claims, further comprising the steps of:
substantially permanently sweeping a wavelength of the first optical signal (62) up and down within a predetermined sweeping range, and
choosing the sweeping range in a way that it covers an absorption feature
25 of the wavelength reference element (18).

5. The method of claim 1 or any one of the above claims, further comprising the steps of:

locking the first optical signal (62) to an absorption feature of the wavelength reference element (18).

- 5 6. The method of claim 1 or any one of the above claims, further comprising the steps of:

detecting a second resulting interference signal (218) being a result of interference of parts of the first optical signal (62) in the interferometer (2),

10 comparing the phase of the first (68) and the second (218) resulting interference signals to evaluate the direction of the drift.

7. The method of claim 1 or any one of the above claims, further comprising the steps of:

locking the first optical signal (62) to an absorption feature of the wavelength reference element (18),

15 coupling a second optical signal (304) into the interferometer (2) and into the wavelength reference element (18),

detecting a third resulting interference signal (68) being a result of interference of parts of the second optical signal (304) in the interferometer (2),

20 locking the second optical signal (304) to a specified position, preferably to an extremum, of the third resulting interference signal (68), and

detecting a change of a beat signal (70) of a superposition of the first (62) and the second (304) optical signal to detect the drift.

- 25 8. The method of claim 1 or any one of the above claims, further comprising the steps of:

providing the first (62) and the second (304) optical signal with substantially the same polarization.

9. The method of claim 1 or any one of the above claims, further comprising the steps of:

5 using the detected drift, if any, for stabilizing the interferometer (2).

10. The method of claim 1 or any one of the above claims, further comprising the steps of:

10 coupling a third optical signal (504) into the interferometer (2) and into the wavelength reference element (18), the third optical signal (504) having a wavelength substantially different from the wavelength of the first optical signal (62),

detecting a third resulting interference signal (68, 218) being a result of interference of parts of the third optical signal (504) in the interferometer (2),

15 locking the third optical signal (504) to an absorption feature of the wavelength reference element (18), and

comparing the first resulting interference signal (68, 218) with the third resulting interference signal (68, 218) to detect a wavelength dependency of the drift, if any.

- 20 11. The method of claim 1 or any one of the above claims, further comprising the steps of:

using the detected drift, if any, for introducing a variable optical delay corresponding to the drift into the interferometer (2).

- 25 12. The method of claim 1 or any one of the above claims, further comprising the steps of:

using the detected drift, if any, for evaluating a property of the

interferometer (2) or a device under test being part of the interferometer (2), the property being a dependency of at least one of the following: temperature, pressure, humidity, magnetism, voltage.

- 5 13. The method of claim 1 or any one of the above claims, further comprising the steps of:

coupling a useful optical signal (4) into the interferometer (2), and

detecting a useful resulting interference signal (21, 23) being a result of interference of parts of the useful optical signal (4) in the interferometer (2) for evaluating a wavelength of the useful optical signal (4).

- 10 14. The method of claim 1 or any one of the above claims, further comprising the steps of:

coupling a useful optical signal (4) into the interferometer (2) along the same path (38) as the first optical signal (62) and having a substantially orthogonal polarization with respect to a polarization of at least one of the following: the first optical signal (62), the second optical signal (304), the third optical signal (504), and

detecting a useful resulting interference signal (21, 23) being a result of interference of parts of the useful optical signal (4) in the interferometer (2) for evaluating the wavelength of the useful optical signal (4).

- 20 15. The method of claim 1 or any one of the above claims, further comprising the steps of:

tuning the useful optical signal (4).

- 25 16. A software program or product, preferably stored on a data carrier, for executing the method of one of the claims 1 to 15 when run on a data processing system such as a computer.

17. An apparatus for monitoring an interferometer (2), comprising:

a first coupler (40) for coupling a first optical signal (62) of a first optical source (60) into the interferometer (2) and into a wavelength reference element (18),

5 a first detector (64) for detecting a first resulting interference signal (68) being a result of interference of parts of the first optical signal (62) in the interferometer (2),

10 a reference detector (66) for detecting a resulting reference signal (70) of the wavelength reference element (18), the resulting reference signal (70) being a result of interaction of the first optical signal (62) with the wavelength reference element (18), and

an evaluating unit (56) for comparing the first resulting interference signal (68) with the resulting reference signal (70) to detect a drift of the interferometer (2), if any.

18. The apparatus of claim 17, further comprising:

15 a first locking circuit (202) for locking the first optical signal (62) to an absorption feature of the wavelength reference element (18).

19. The apparatus of claim 17 or any one of the above claims, further comprising:

20 a second detector (214) for detecting a second resulting interference signal (218) being a result of interference of parts of the first optical signal (62) in the interferometer (2),

the evaluation unit (56) being designed for comparing the phase of the first (68) and the second (218) resulting interference signals to evaluate the direction of the drift.

25 20. The apparatus of claim 17 or any one of the above claims, further comprising:

a first locking circuit (202) for locking the first optical signal (62) to an absorption feature of the wavelength reference element (18),

5 a second coupler (40) for coupling a second optical signal (304) of a second optical source (302) into the interferometer (2) and into the wavelength reference element (18),

a third detector (64) for detecting a third resulting interference signal (68) being a result of interference of parts of the second optical signal (304) in the interferometer (2) ,

10 a second locking circuit (308) for locking the second optical signal (304) to a specified position, preferably to an extremum, of the third resulting interference signal (68), and

a fourth detector (66) for detecting a change of a beat signal (70) of a superposition of the first (62) and the second (304) optical signal to detect the drift.

15 21. The apparatus of claim 17 or any one of the above claims, further comprising:

the first and the second coupler (40) comprising the same polarization beam splitter (40) for providing the first (62) and the second (304) optical signal with substantially the same polarization.

20 22. The apparatus of claim 17 or any one of the above claims, further comprising:

a stabilizing unit (56) for stabilizing the interferometer (2) on the basis of the drift detected by the evaluation unit (56).

25 23. The apparatus of claim 17 or any one of the above claims, further comprising:

a third coupler (40) for coupling a third optical signal (504) into the

interferometer (2) and into the wavelength reference element (18), the third optical signal (504) having a wavelength substantially different from the wavelength of the first optical signal (62),

5 a fifth detector (64) detecting a third resulting interference signal (68, 218) being a result of interference of parts of the third optical signal (504) in the interferometer (2),

a third locking circuit (510) for locking the third optical signal (504) to an absorption feature of the wavelength reference element (18), and

10 the evaluation unit (56) being designed for comparing the first resulting interference signal (68, 218) with the third resulting interference signal (68, 218) to detect a wavelength dependency of the drift, if any.

24. The apparatus of claim 17 or any one of the above claims, further comprising:

15 a variable optical delay unit (402) for introducing a variable optical delay into the interferometer (2) on the basis of the drift detected by the evaluation unit.

25. The apparatus of claim 17 or any one of the above claims, further comprising:

20 the evaluating unit (56) being designed to evaluate a property of a device under test being part of the interferometer (2), the property being dependent on at least one of the following: temperature, pressure, humidity, magnetism, voltage.

26. The apparatus of claim 17 or any one of the above claims, further comprising:

25 a fourth coupler (40) for coupling a useful optical signal (4) of a fourth optical source (6) into the interferometer (2),

a sixth detector (22, 24) for detecting a useful resulting interference signal (21, 23) being a result of interference of parts of the useful optical signal (4) in the interferometer (2), and

5 the evaluating unit (56) being designed to evaluate a wavelength of the useful optical signal (4).

27. The apparatus of claim 17 or any one of the above claims, further comprising:

10 a polarization beam splitter (40) for coupling a useful optical signal (4) of a fourth optical source (6) into the interferometer (2) with a polarization orthogonal to a polarization of at least one of the following: the first optical signal (62), the second optical signal, the third optical signal (504),

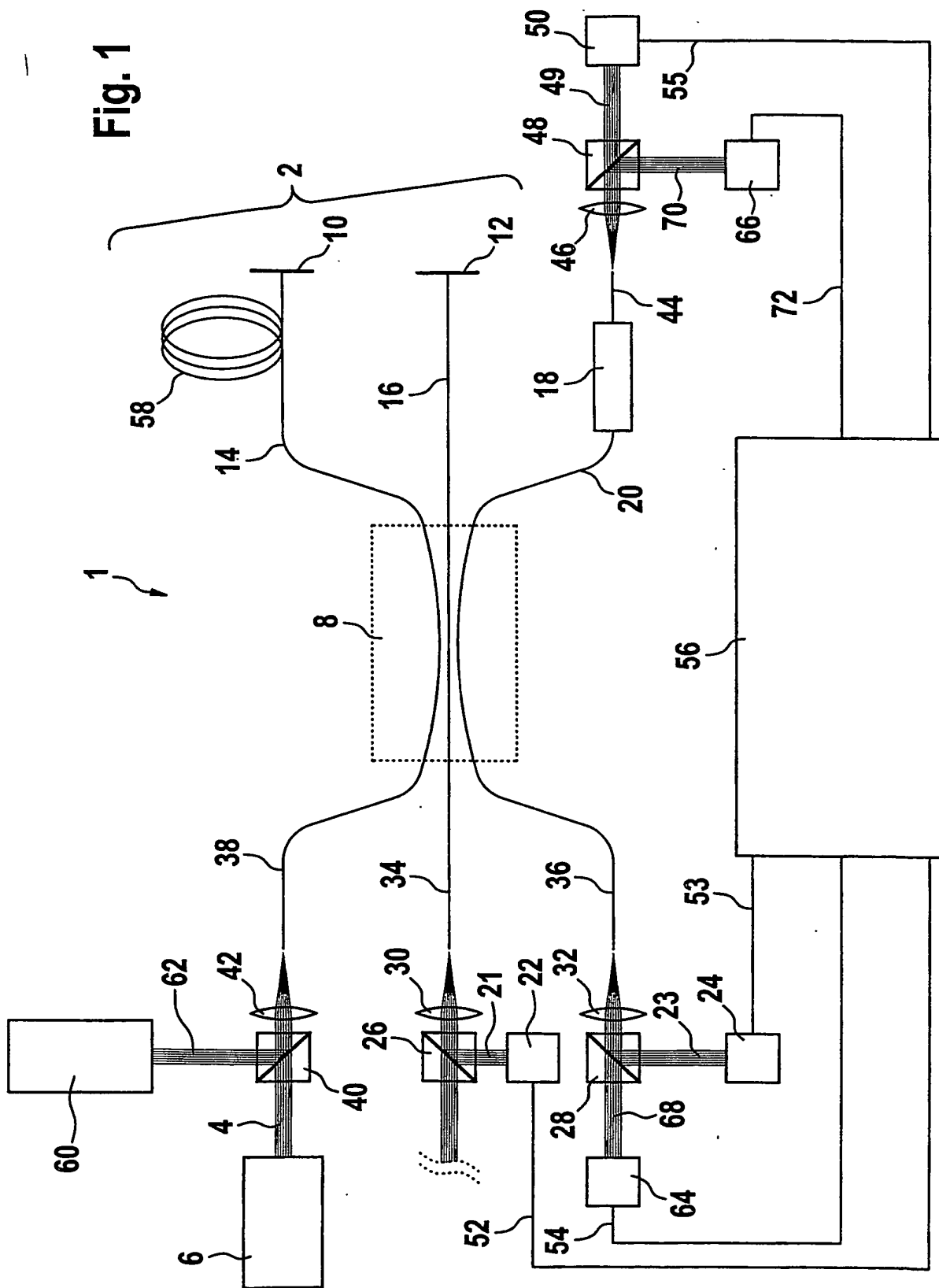
a seventh detector (22, 24) for detecting a useful resulting interference signal (21, 23) being a result of interference of parts of the useful optical signal (4) in the interferometer (2), and

15 the evaluation unit (56) being designed for evaluating the wavelength of the useful optical signal (4).

28. The apparatus of claim 17 or any one of the above claims, further comprising:

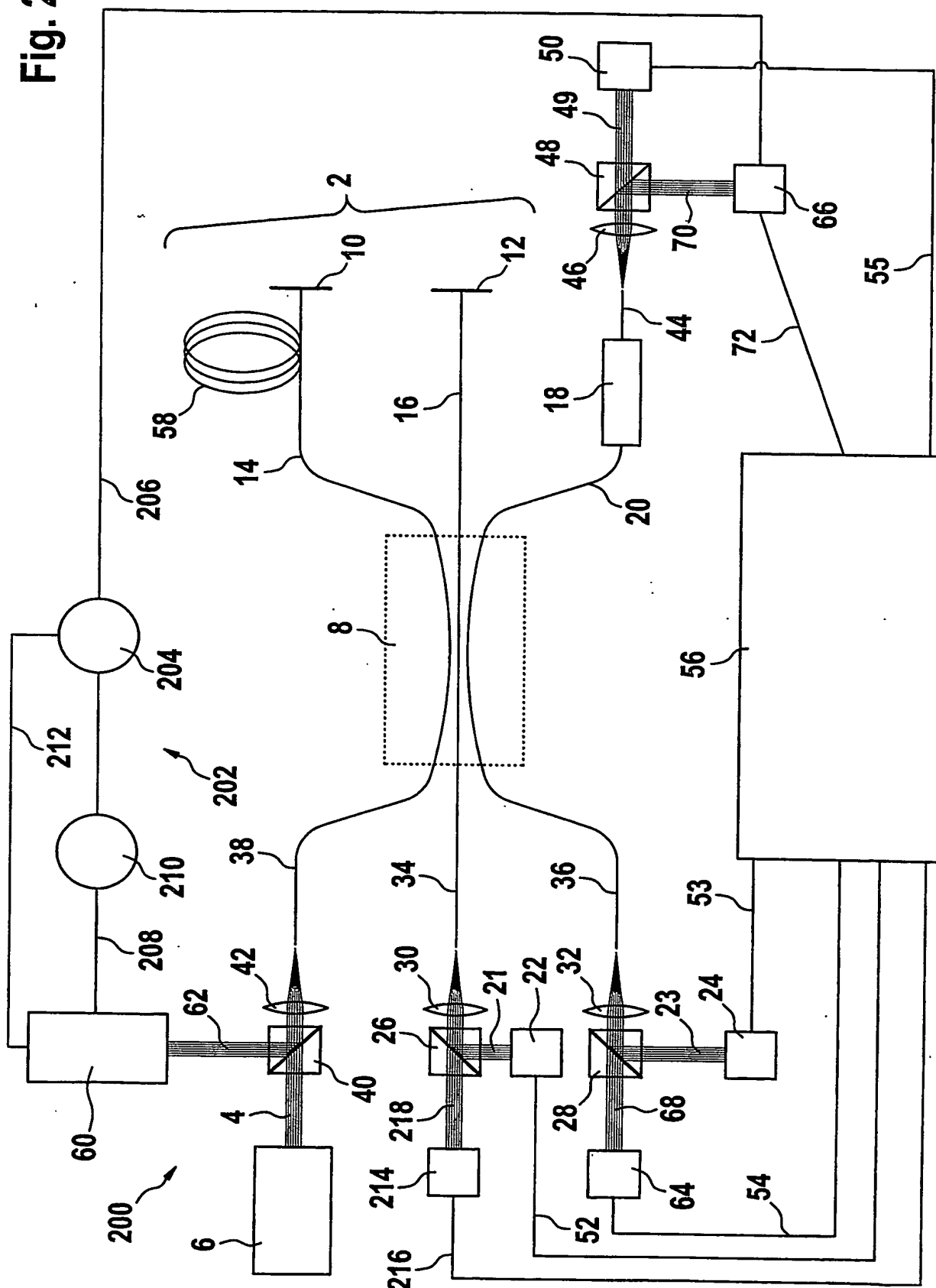
the fourth optical source (6) being a tunable laser source.

20



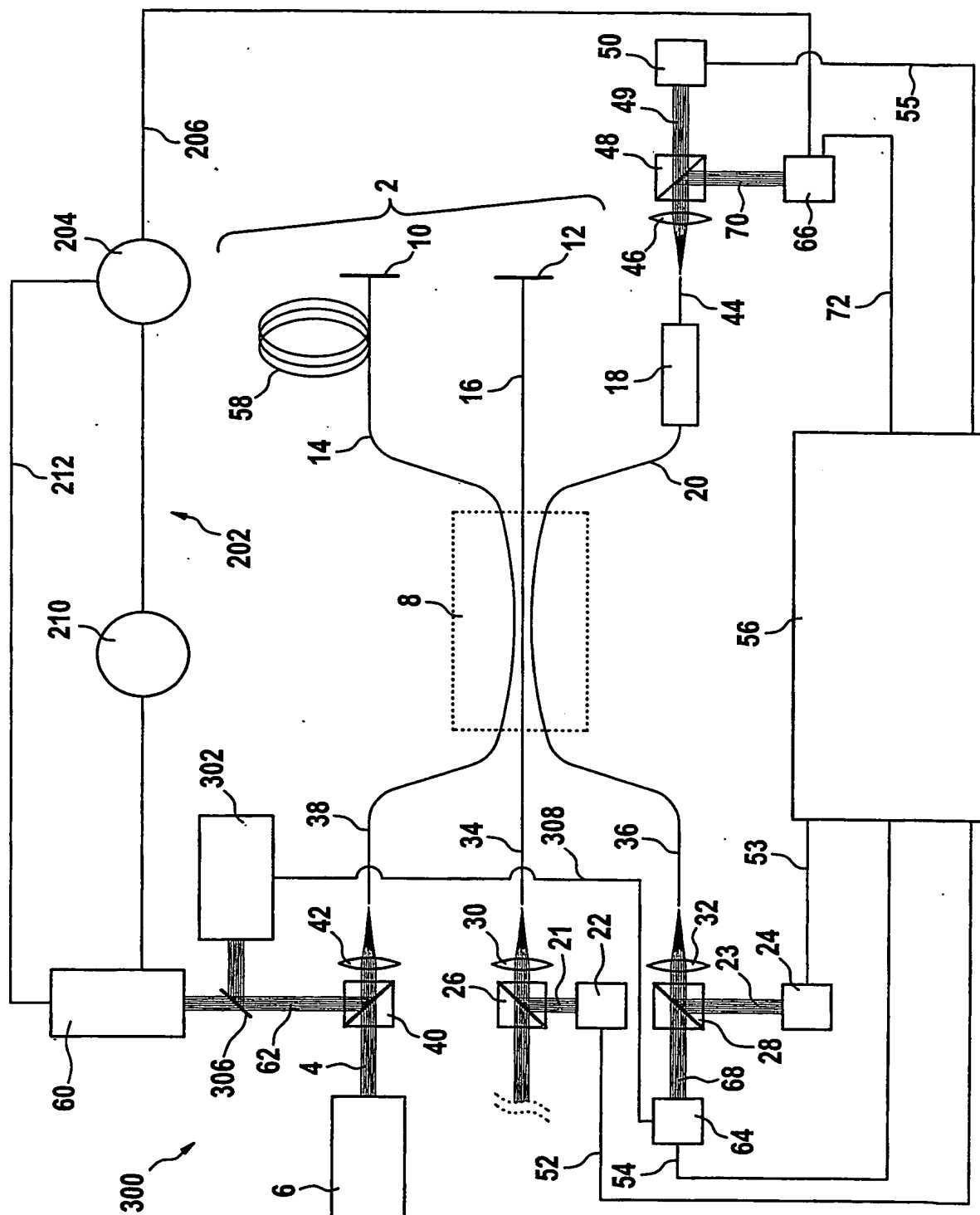
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Fig. 2



SUBSTITUTE SHEET (RULE 26)

Fig. 3



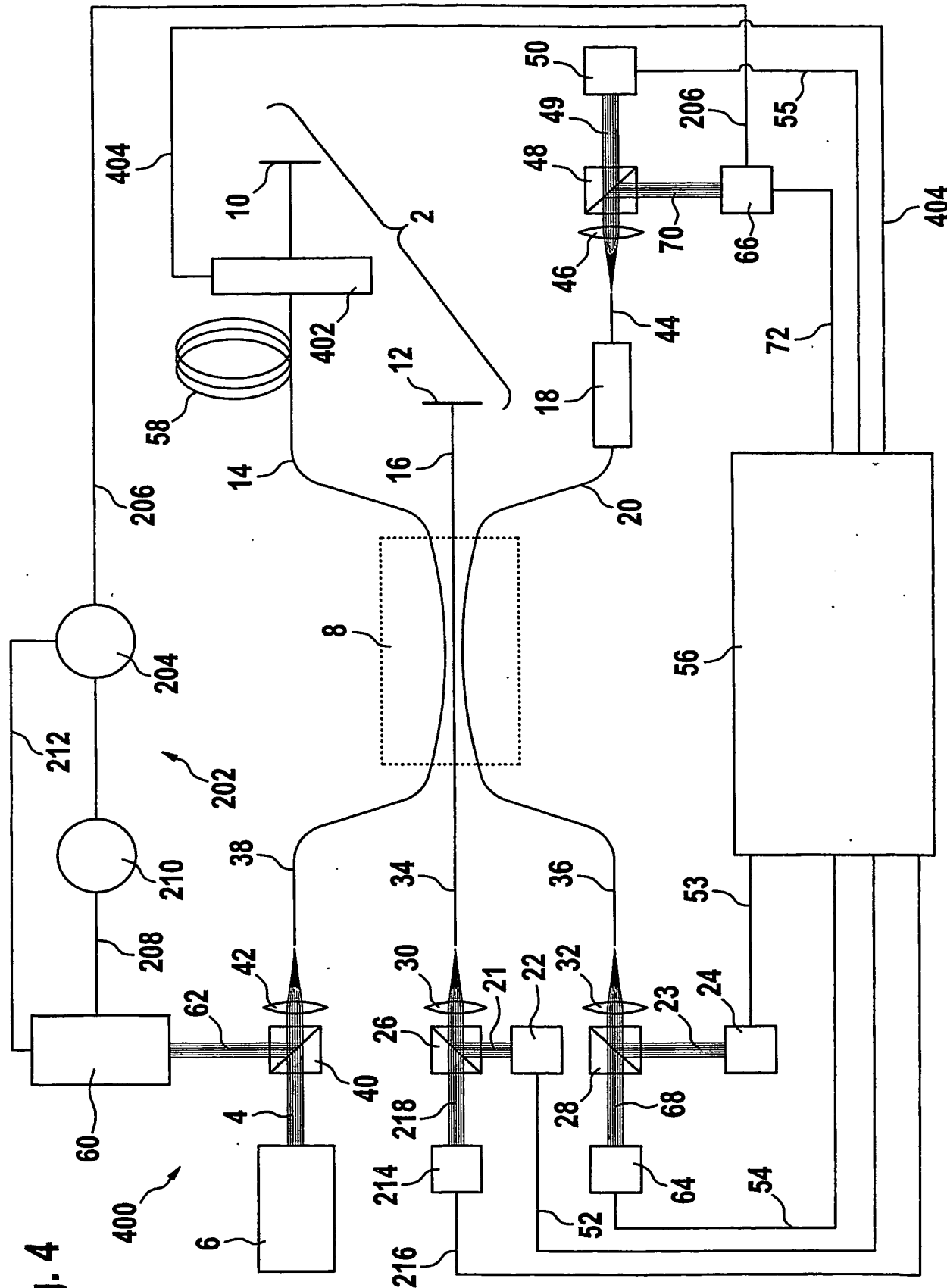


Fig. 4

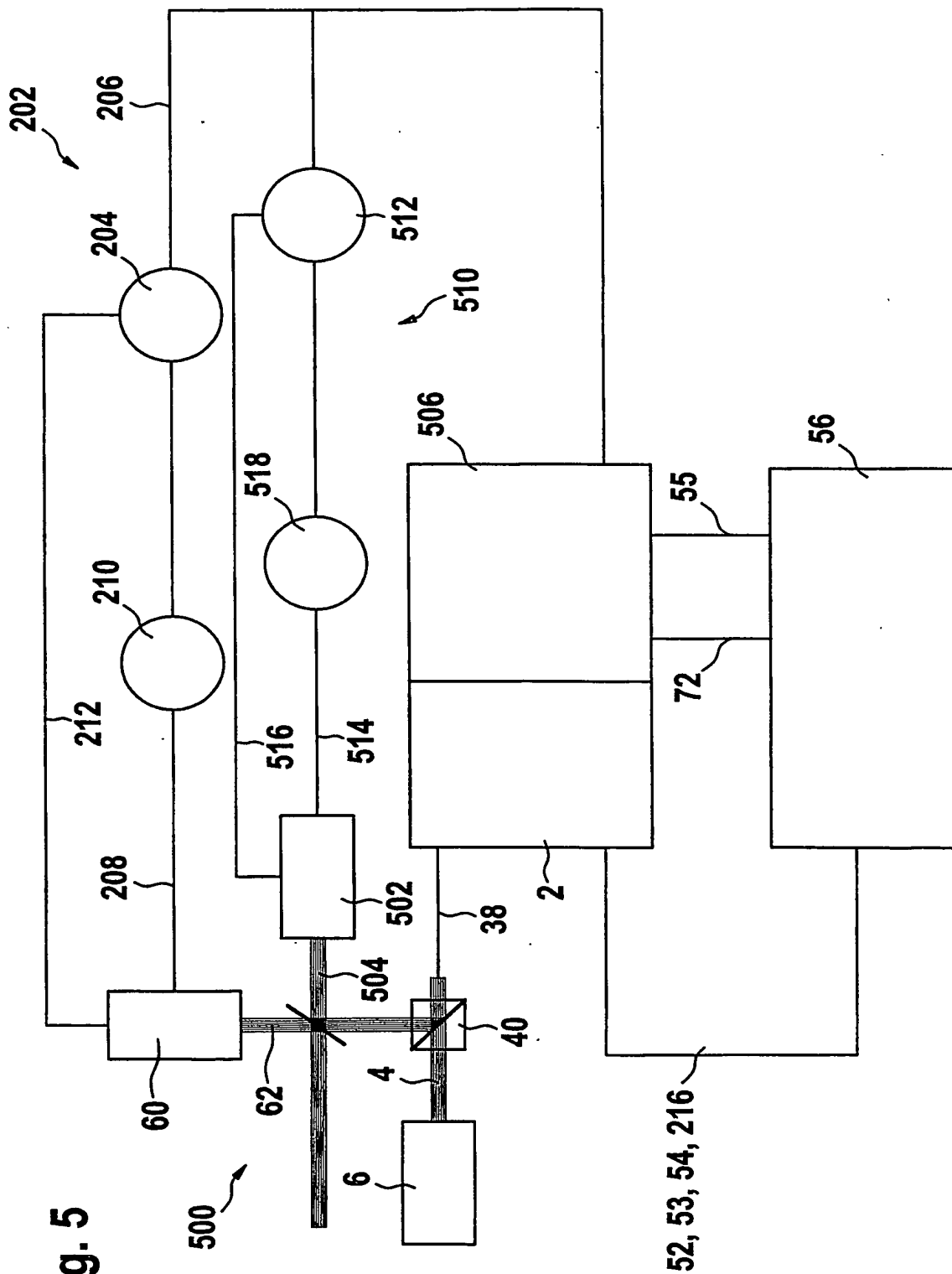


Fig. 5

PCT

REC'D 02 JUL 2003

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INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 20020305	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, Item 5 below.	
International application No. PCT/EP 02/ 11390	International filing date (day/month/year) 11/10/2002	(Earliest) Priority Date (day/month/year)
Applicant AGILENT TECHNOLOGIES, INC.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

- a. With regard to the **language**, the International search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☐ the text is approved as submitted by the applicant.

☒ the text has been established by this Authority to read as follows:

INTERFEROMETER MONITORING

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

1
☐ None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 02/11390

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 G01B9/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G01B G01J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 1 172 637 A (AGILENT TECHNOLOGIES INC A DEL) 16 January 2002 (2002-01-16) column 3, line 14 -column 5, line 28	1-5, 16, 17
A	US 2002/131045 A1 (ANDERSON DUWAYNE R) 19 September 2002 (2002-09-19) abstract	1, 17
A	FR 2 629 197 A (MAITRE ATELIERS) 29 September 1989 (1989-09-29) claims 1,2	1, 17
A	WO 98 38475 A (ABERLINK TECHNOLOGY) 3 September 1998 (1998-09-03) abstract	1, 17

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the International filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the International filing date but later than the priority date claimed

- *T* later document published after the International filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- * & * document member of the same patent family

Date of the actual completion of the International search

20 June 2003

Date of mailing of the International search report

03/07/2003

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 02/11390

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